REMARKS

Claims 7-9, 12-17 and 20-23, all the claims pending in the application, stand rejected. Claims 7 and 12 are amended.

Claim Rejections - 35 USC §112

Claim 23 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. This rejection is traversed for at least the following reasons.

The Examiner asserts that claim 23 contains a reference to "an isotropical etching step". The Examiner does not find support for this limitation in the claim and asserts that one of ordinary skill in the art would not necessarily have been apprised of this limitation. Isotropic etching is disclosed at least at pages 19 and 27.

Claims 21 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This rejection is traversed for at least the following reasons.

In framing the rejection, the Examiner states that each of the claims 20 and 21 recite the limitation wherein the polishing step is performed to provide the glass substrate with a "flatness required for a selected one of ArF excimer laser, F2 excimer laser, and EUV". The Examiner asserts that the Applicant has failed to adequately define the requisite flatness, and concludes that one of ordinary skill would not necessarily be apprised of such flatness, rendering the claim unclear and indefinite.

Applicant respectfully submits that the application clearly teaches to one skilled in this art, who is familiar with the demands for various lasers, that flatness is an important issue. The specification observes in the Background of the Invention that:

> In recent years, with the trend toward further miniaturized patterns, higher accuracy has been required for loading a photomask (reticle) on a stepper of an exposure machine, and it has been also required that glass substrates have accuracy in the configuration (**flatness**) of the edge surfaces of glass substrates. If the edge surfaces of glass substrates have poor configuration accuracy (e.g., turned-down edges on the substrate edge surfaces), then the suction of the substrates are not securely carried out when loading them on the steppers, resulting in poor positional accuracy at loading.
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> The glass substrates used for lithography of mask blank glass substrates are required to exhibit higher **flatness** and smoothness as exposure wavelengths become shorter (with increased miniaturization of patterns). For the exposure wavelengths of an ArF excimer laser (wavelength: 193 nm) and an F2 excimer laser (wavelength: 157 nm), the smoothness is required to be 0.2 nm or less in terms of the root mean square roughness (RMS), or 0.15 nm or less in terms of the root mean square roughness (RMS) at EUV (wavelengths of 13 to 14 nm). Under the etching conditions set forth above, the surfaces of the glass substrates are roughened, failing to meet the requirements.

Further, in describing the present invention, the inventors teach that:

> An amount of etching below 0.01 .mu.m is not desirable, because it would make it difficult to determine the presence of a crack in the defect inspection step carried out after the precision polishing step. On the other hand, an amount of etching over 0.2 .mu.m is not desirable, either, because the surface roughness and the surface configuration (**flatness**) would deteriorate as a result of the etching of the glass substrate.
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> The etching rate in the etching process is preferably 0.2 nm/min. to 2.0 nm/min. An etching rate below 0.2 nm/min. is not desirable, because it would not sufficiently elicit latent defects. On the other hand, an etching rate over 2 nm/min. is not desirable, either, because it would badly affect the surface roughness and the surface configuration (**flatness**) due to quick corrosion of the glass substrate. A preferable range is 0.3 nm/min. to 0.7 nm/min.

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The measurement of the configurations of the glass substrate edge surfaces (turned-down edge amounts) performed by a stylus type roughness gauge (Surftest 501) according to the above definition indicated good results, the turned-down edge amounts of all the glass substrates lying within the range of -0.5 .mu.m to -0.25 .mu.m. Furthermore, the measurement of the **flatness** of the main surfaces of the glass substrates performed using a **flatness** measuring instrument (FM200 made by Troppel) indicated good results, the **flatness** of all the main surfaces of the glass substrates being 1 .mu.m or less.

The obtained glass substrates can be used as the glass substrates for the mask blanks for ArF excimer lasers and the glass substrates for the mask blanks for F2 excimer lasers.

From the foregoing, one skilled in the art would clearly understand the requirements that the invention would meet with respect to flatness. Accordingly, the rejection should be withdrawn.

Claim Rejections ~35 USC § 102

Claims 7, 8, 12, 13, 16, 20, 21, and 23 are rejected under 35 U.S.C. 102(b) as be[i]ng clearly anticipated by Walker (US 2,372,536). This rejection is traversed for at least the following reasons.

Walker

In framing the rejection, the Examiner asserts that Walker teaches an improved method for preparing precision polished glass surfaces having a flatness. The Examiner states that in Walker, a glass substrate is first subjected to a rough grinding process and after the rough grinding "it is extremely difficult to properly inspect a stock piece for the presence of relatively deep scratches or marrings or internal inclusions or striae or other imperfections" (pg 2, Column 2, Lines 46-74). Thus, Walker subjects the substrate to immersion in a reactive chemical agent

or etching solution which removes the surface debris and rounds off the edges of the workpiece. Also, after the etching treatment, which is considered isotropic, "any relatively deep surface scratches or other mars will now be readily discernible". Then, the etched substrate is further subject to a fine polishing or precision polishing (Page 3, Column 2, Lines 45-46). After precision polishing, the substrate is optionally subjected to a final dip or "cleaning step" in an etchant solution or chemical debris-clearing solution (Page 5, Lines 17-38)

Claims 7 and 12

Applicants respectfully submit that, in connection with the present invention, the etching step for eliciting the crack is performed after the rough polishing step and before the precise polishing step, as described on page 24 of the English specification, and is never performed after a grinding step and before a rough polishing step, as mentioned in Walker. As well known in the art, a polishing step is clearly distinguished from a grinding step.

By contrast, Walker's method includes a step of coarse grinding a stock piece, a step of treating a surface structure with a glass-reactive chemical solution to remove debris of the coarse grinding and to brighten the facets of a serrated structure, and a step of finally fine grinding the serrated structure until substantially all of the brightened facet portions are eliminated. From this fact, it is readily understood that disclosure of Walker is directed only to the coarse and the finally fine grinding steps and is not directed to the polishing step. At any rate, in Walker an acid surface clearing step is performed within the grinding steps before a polishing step (page 3, column 2, lines 14 to 26) and is never performed within the polishing steps. In other words, no teaching is made at all in Walker about necessity of performing the acid surface clearing step.

In addition, the acid surface clearing step in Walker is for removing a surface with a lot of the debris or cracks which result from the grinding step.

In marked contrast, Applicant's method is featured by performing the etching step after the rough polishing step and before the precise polishing step, as described with reference to Fig. 1. Herein, the precise or post polishing step is for obtaining a mirror surface which has extremely high flatness and on which it is very hard to detect a defect. Under the circumstances, the present invention proposes to intentionally widen cracks by the etching step prior to the post polishing step and to facilitate detection of widened cracks.

Now, consideration is made about the case where the etching step is performed after the grinding step (not the polishing step). In this case, a surface after the grinding step is roughened and has a lot of cracks and debris, as shown in figures attached to Walker. Therefore, the cracks cannot be elicited even if the etching step is performed after the grinding step.

As a result, in order to obtain a mirror surface, a precise polishing step should be continued for a long time after such an etching step and such a long time precise polishing step results in an increase of a turned-down edge amount, as suggested on page 13 of the instant specification.

For the foregoing reasons, Applicants respectfully submit that Walker is not relevant to the presently claimed invention and the rejection should be withdrawn.

Claim Rejections ~35 USC § 103

Claim 15 is rejected under 35 U.S.C, 103(a) as being unpatentable over Walker

(2,372,536). This rejection is traversed for at least the following reasons.

The reversal of steps in Walker would not be obvious, as there is no teaching or suggestion for changing the steps. Moreover, such change would be contrary to the direction taught and clearly preferred by Walker. The Examiner admits that Walker is silent regarding a specific depth of substrate material to be removed, but concludes that it would have been well within the prevue of one of ordinary skill in the art at the time of the invention to provide a cleaning step etch of between 0 to 10nm as claimed. Given the completely different step sequence in the two references, there is no basis for the Examiner's conclusion. Only Applicant teaches the optimum way to achieve the desired flatness and effective result.

Claims 9, 14, 17, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Walker (2,372,536) in view of Feng (6,596,042). This rejection is traversed for at least the following reasons.

The Examiner admits that Walker fails to explicitly provide a limitation upon the amount of material removed from either the etching step or the final cleaning step as set forth in Claims 15 and 17, respectively, and that Walker is silent on the nature of the abrasive utilized in the polishing procedures as required in claim 22 or upon the root mean square roughness of the in final optical element as per claims 9 and 14.

The Examiner looks to Feng for a teaching of what the Examiner characterizes as "common techniques, materials, and tolerances considered to be known to skilled practitioners in the field of precision polishing or Chemical-Mechanical polishing (CMP)."

The cited portions of the reference and the asserted teachings of one skilled in the art do

not lead to the change of steps in Walker that provide a patentable distinction for the claimed invention.

The Examiner asserts that in light of the Feng disclosure and absent any compelling or unexpected results to the contrary, it is the Examiners position that precision polishing operations which use colloidial silica and/or cerium oxide abrasive particles [Claim 22] and which remove between 10 and 200nm of silica [Claim 17] to yield a surface RMS value of 0.2nm [Claims 9, 14] are well within the prevue of one of ordinary skill in the art. However, there is no teaching or suggestion that one skilled in the art should use the sequence of steps described and claimed by the Applicant. In the absence of such teaching, there is no basis for the rejection. Thus, the claims clearly are patentable.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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